The 2nd Visual Object Tracking Segmentation VOTS2024 Challenge Results

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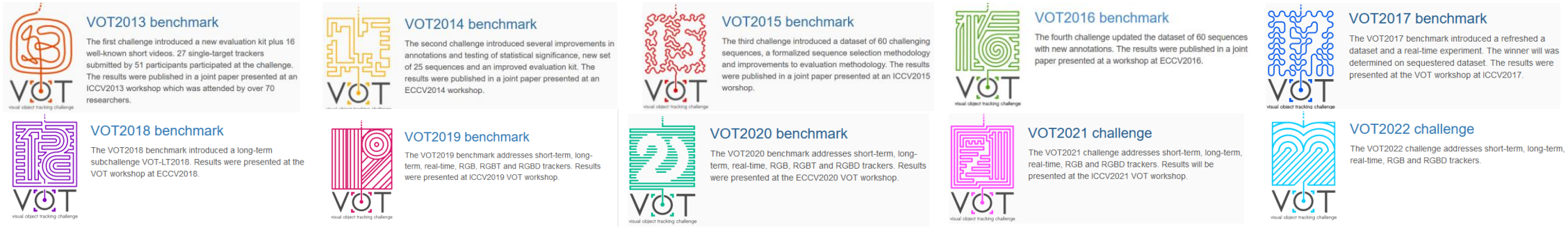
VOTS2024 challenge

- The VOT formed in 2013 to support general object trackers
- Tracking objects that do not change their topology

  (don't break apart or turn inside-out)

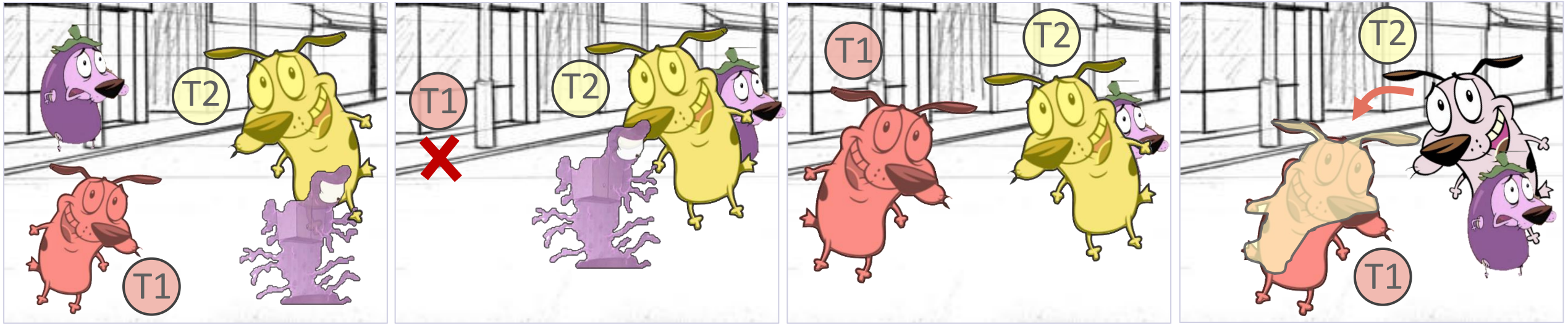


- In 2023 VOT challenges converged into VOTS:

  segmentation-based general object tracking no longer distinguishing between single-target, multi-target, short-term and long-term tracking

The VOTS2024 challenge scope

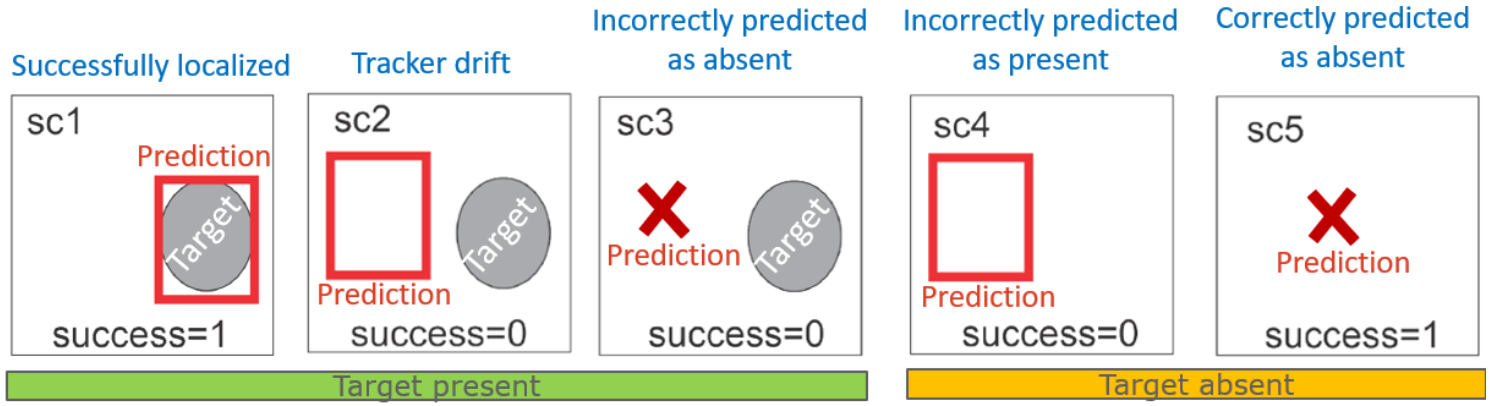
- General object Short/Long-term, Single/Multi-target segmentation trackers
- Initialize on all targets in the first frame and report position in the rest



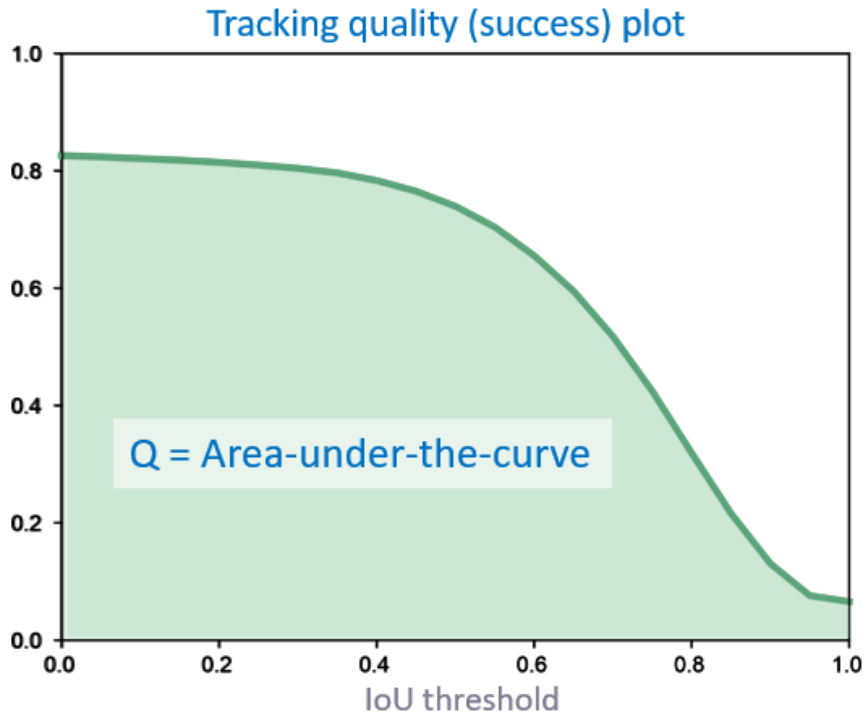
- Determine the target absence and redetect when it reappears
- Drifting off the target to background or another object is considered failure

VOTS Primary performance measure *Q*

- VOTS2023 *tracking success* accounts for 5 scenarios:



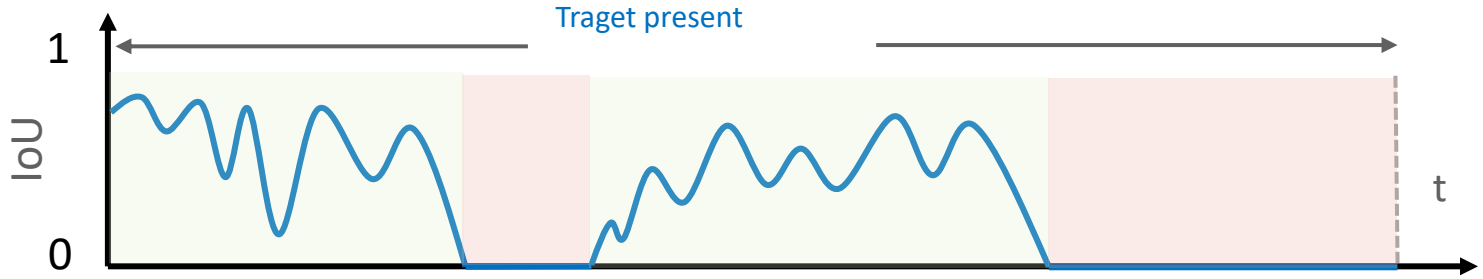
- Tracking quality plot:
  - Average of success plots calculated for each target in each sequence

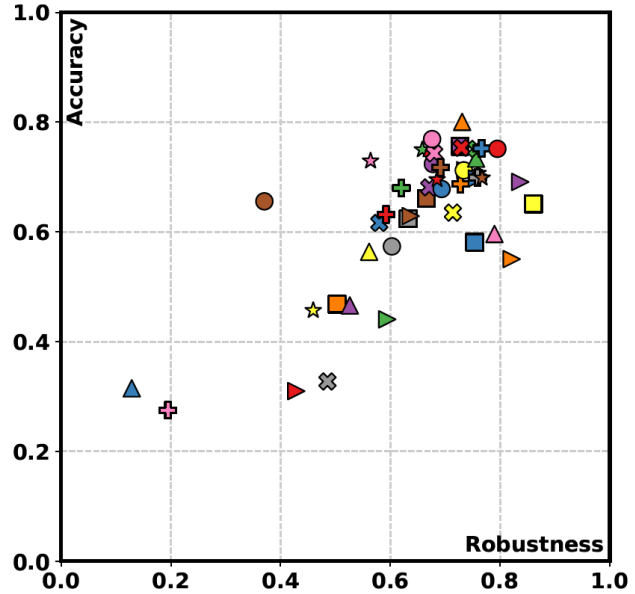


- Primary measure: *Tracking quality Q* (area-under-the-curve)

VOTS Auxiliary performance measures

- Accuracy/Robustness (@IoU=0.0 when target present)





"Why did the tracker fail while target visible?"

- NotReportedError (NRE): % frames incorrectly predicted target absent
- DriftRateError (DRE): % frames tracker drifted while predicting target present

"How well is target absence determined?"

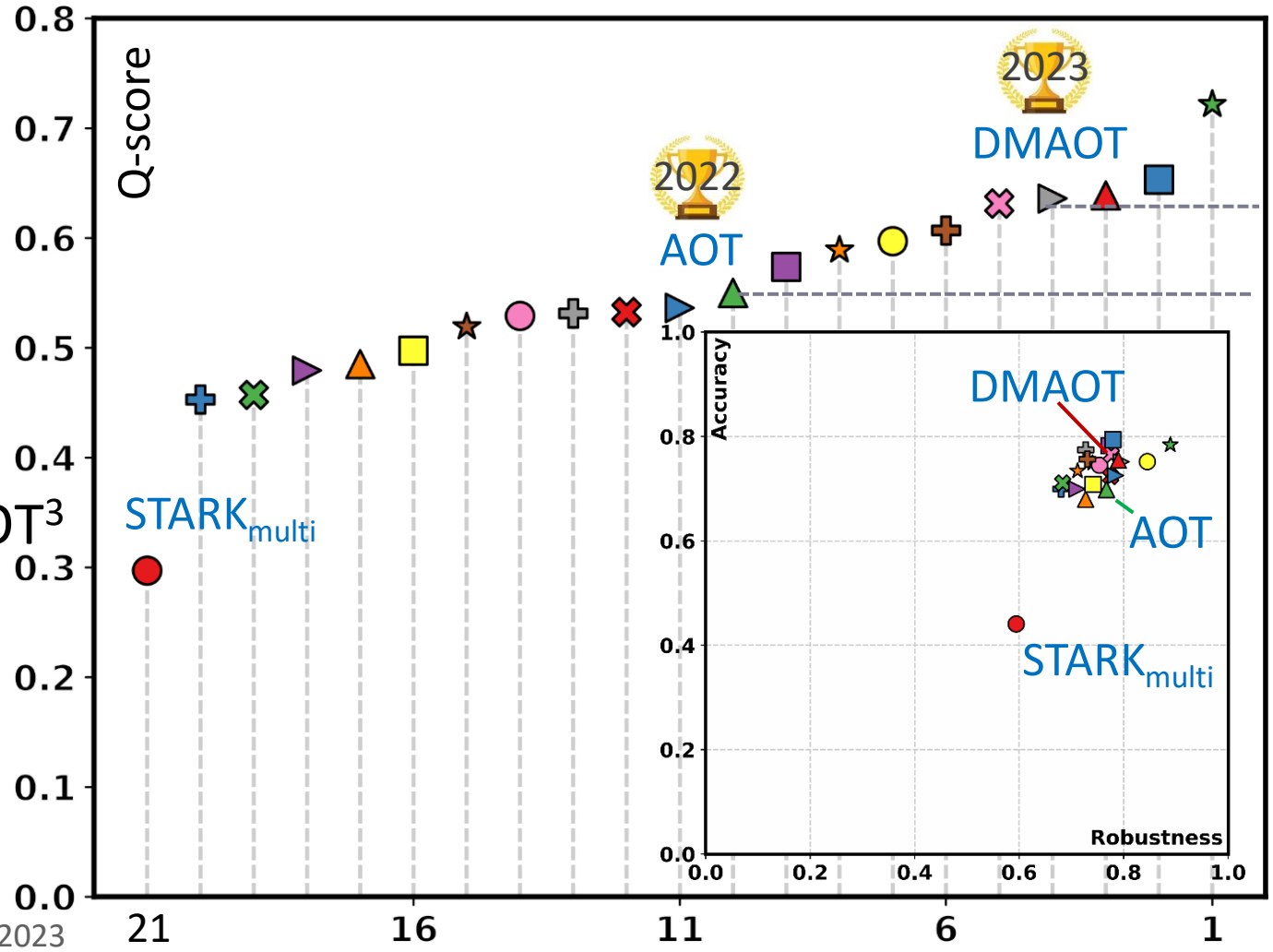
- AbsenceDetectionQuality (ADQ): % frames target correctly predicted absent

VOTS2024 dataset: same as VOTS2023

- Stats: 144 sequences ; 341 targets ; 168 targets leave the FOV at least once
- Sequence properties:
  - min/max = 63/10.7k frames
  - On average 2.37 targets per sequence annotated
  - Median target absence: 18 frames
- To prevent overfitting:
  - Sequences + initialization frames GT publicly available.
  - GT of test frames sequestered, evaluation carried out on a dedicated server.

VOTS2024 challenge results: 18 trackers tested

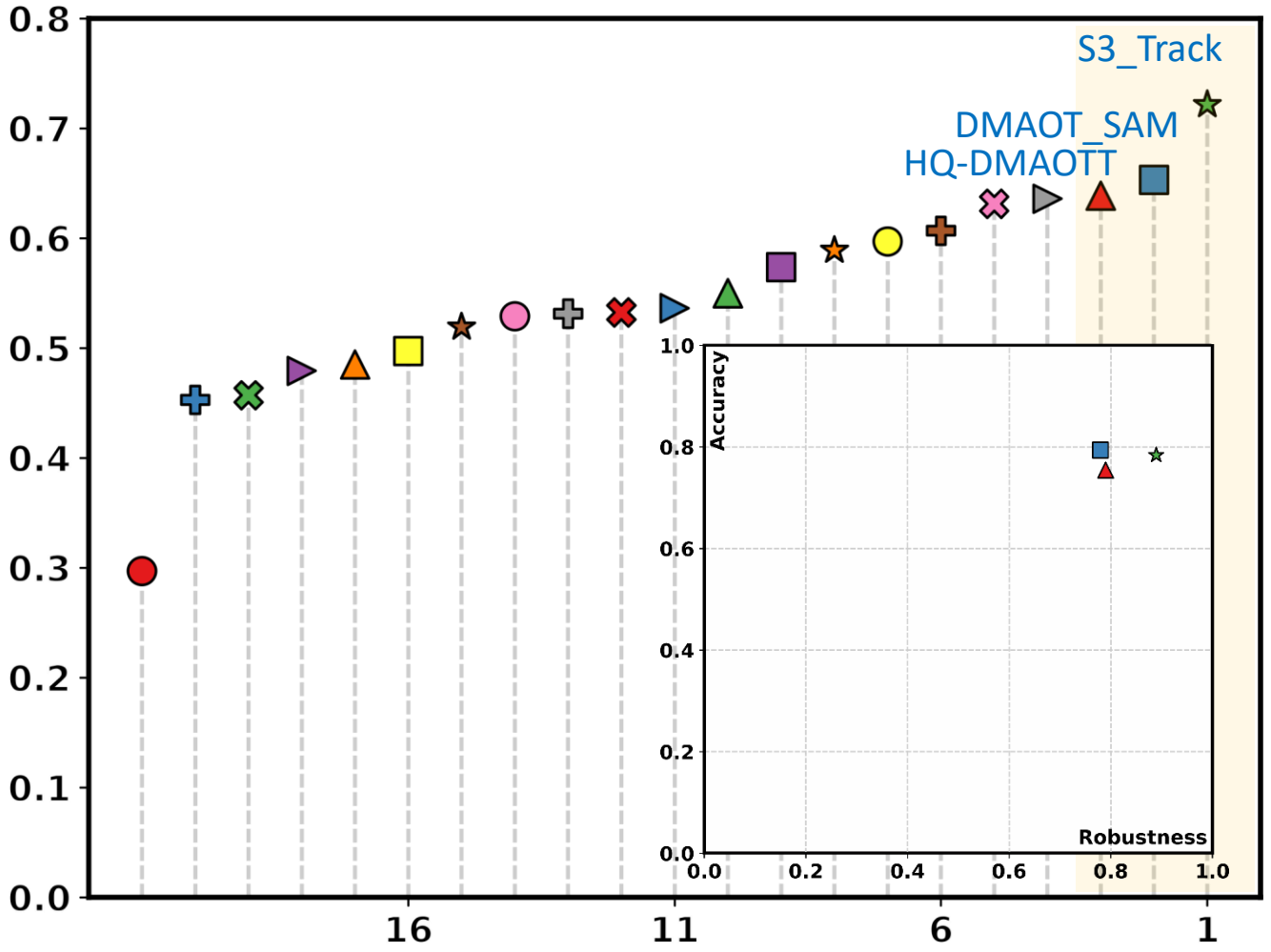
- Baseline 1: Independent STARKs[1] (41% in Q-score w.r.t. top tracker)
  all submissions outperform it
- Baseline 2: VOT2022 winner AOT[2]
  44% (8 trackers) outperfrom it
- Baseline 3: VOTS2023 winner DMAOT[3]
  17% (3 trackers) outperfrom it



[1] Yan, et al. ICCV2021; [2] Yang, et al. NeurIPS 2021 ; [3] Cheng, et al. VOTS 2023

VOTS2024 challenge top 3 trackers

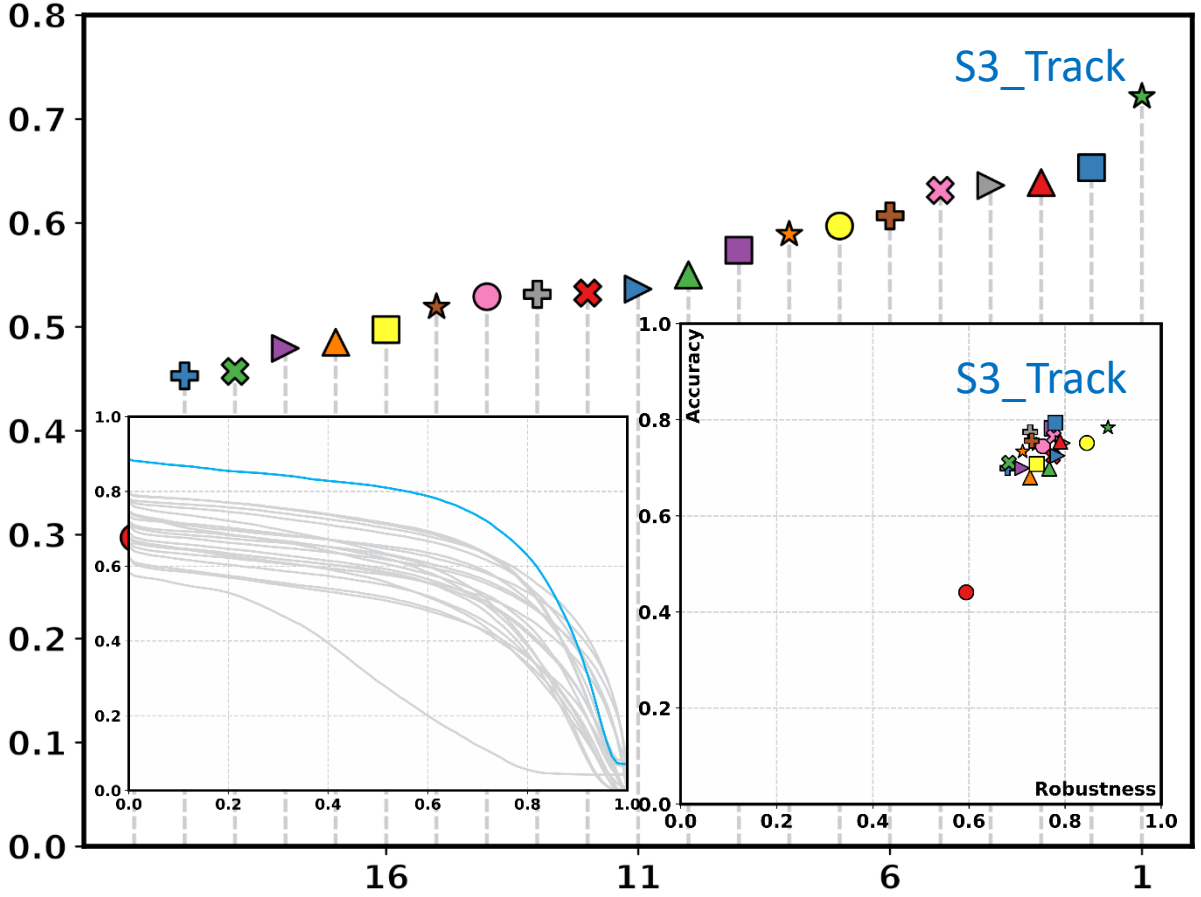
- Top 3 trackers: S3_Track, DMAOT_SAM, HQ-DMAOTT
  - S3_Track:
    - Single-stage architecture
    - Extends Cutie[1] by multi-scale features + ViT backbone +…
  - DMAOT_SAM & HQ-DMAOTT:
    - Two-stage architecture
    - DMAOT[1] for the initial mask prediction, then refine by SAM[3]
- All apply: ViT/Swin backbones + large training datasets



[1] Cheng, et al. CVPR2024; [2] Cheng, et al. VOTS 2023; Kirillov et. al. ICCV2023

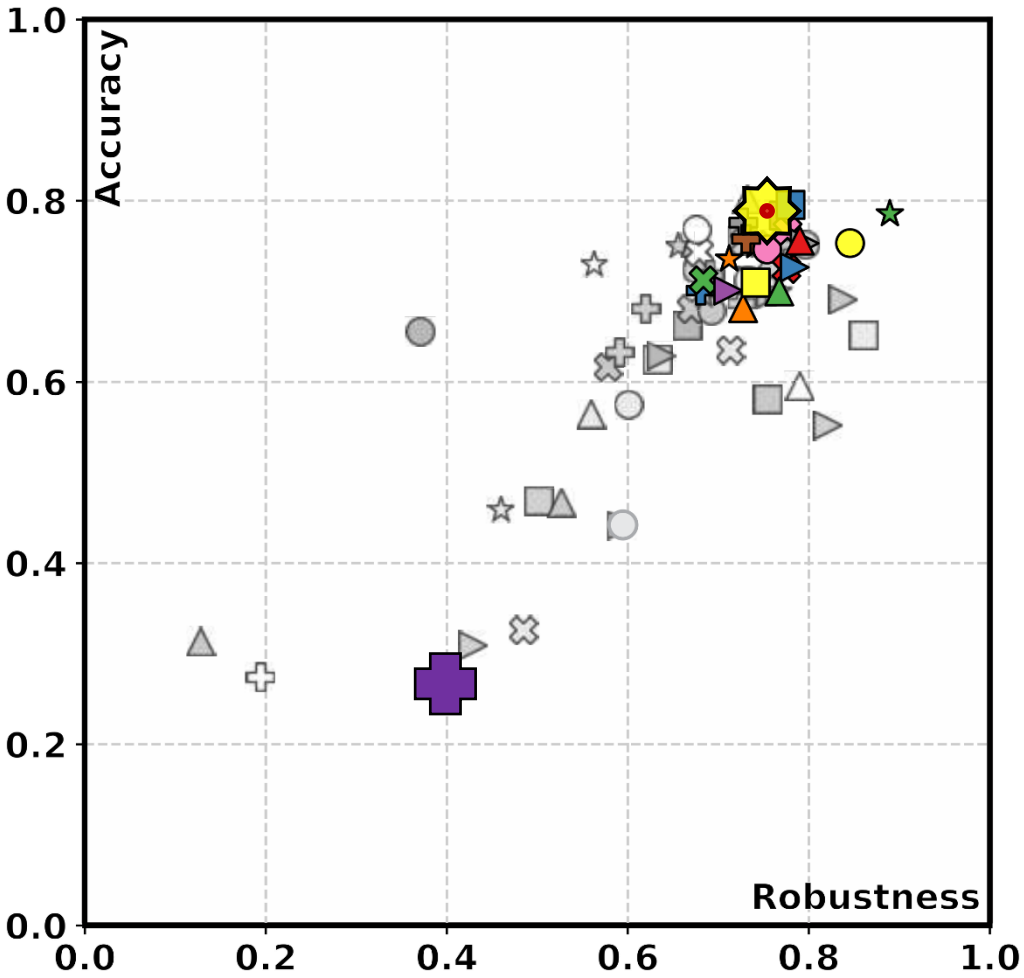
VOTS2024 top-ranked tracker S3_Track

- *Q-score = 0.722* (>10% improvement over second-best)
- VOTS aux measures: *A=0.784, R=0.889 , DRE=0.04 , NRE=0.07, ADQ=0.781*
- Good segmentation accuracy 78.4%
  (DMAOT_SAM; A=79.4%)
- On-target in ~89% of frames
- Localization failure 11% due to:
  - Falsely reported target absent: 63%
  - Drifting: 37%
- Accurately predicts target absence in 78% cases



VOTS2024 vs VOTS2023

- Compared to 2023, 2024 submissions improved on accuracy as well as robustness
  - VOTS2023 winner Q-score: 0.636
  - VOTS2024 top Q-score: 0.722
    (13% winner performance boost)
- "Ancient" history (10 years):
  - 2014 sota KCF[1]: Q=0.107, A=0.268, R=0.403
- SAM2[2]: Q=0.642, A=0.789, R=0.75
  - Outperforms last-year's winner by 1% in Q
  - Would have ranked 3rd in Q-score on VOTS2024



[1] Henriques, et al. ECCV2012; [2] Ravi, et al. Arxiv2024

VOTS2024 challenge
Winners:

S3_Track by: Deshui Miao, Xingsen Huang, Xin Li, Dongmei Jiang, Ming-Hsuan Yang, Yaowei Wang

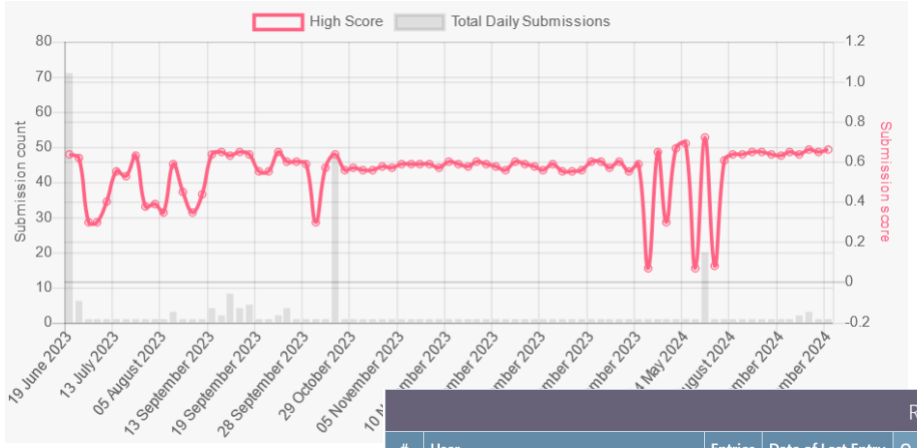
"Associating Semantic Tracker"

Winners talk end of Session I
@10:15

Summary

- Presented VOTS2024 results

- Evaluation server open for post-challenge evaluation



RESULTS

#	User	Entries	Date of Last Entry	Q ▲	Acc ▲	Rob ▲	NRE ▲	DRE ▲	ADQ ▲
1	VOTS2024_S3_Track	4	07/08/24	0.72 (1)	0.78 (5)	0.89 (1)	0.07 (36)	0.04 (74)	0.78 (6)
2	hello_world	11	09/22/24	0.66 (2)	0.79 (3)	0.79 (11)	0.14 (26)	0.07 (66)	0.72 (16)
3	civa_	1	09/20/24	0.66 (3)	0.78 (8)	0.80 (9)	0.14 (28)	0.06 (69)	0.76 (9)
4	civa_lab_	2	09/18/24	0.65 (4)	0.79 (4)	0.79 (12)	0.14 (25)	0.07 (65)	0.72 (15)
5	VOTS2024_dmaot_sam	1	07/08/24	0.65 (5)	0.79 (2)	0.78 (17)	0.14 (22)	0.08 (61)	0.73 (11)

VOTS2024 benchmark

Thanks

- The VOTS2024 committee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VOTS2024 benchmark

- VOTS2024 sponsors:

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